A SURVEY OF THE MARINE ENVIRONMENT NEAR THE CITY OF SEASIDE OCEAN OUTFALL 1/

by

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ABSTRACT

Department biologists, under contract for the State Water Resources Control Board, conducted a survey of the marine environment in the vicinity of the City of Seaside ocean outfall. Survey procedures included benthic grabs, diver observations, bottom trawls, and measurements of water temperature and dissolved oxygen concentrations. Faunal distribution appeared to be more dependent on water depth and substrate type rather than to proximity to the discharge. Water temperatures and dissolved oxygen were normal, however, a surface slick was observed in the immediate vicinity of the discharge.

1/ Marine Resources Administrative Report No. 6, August 1973

2/ California State Fisheries Laboratory, Marine Resources Region, 350 Golden Shore, Long Beach, California 90802

INTRODUCTION

The California Department of Fish and Game and the State Water Resources Control Board (through Regional Board #3, Central Coast) entered into an agreement whereby Department biologists conducted a subtidal ecological investigation of the marine environment in the vicinity of the City of Seaside ocean outfall. The objective of the study was to provide the Regional Water Quality Control Board with data to assist them in evaluating the effects of the discharge on the marine environment.

The determinations made by biologists included: (i) the number and diversity of marine life; (ii) substrate characteristics; and (iii) physical parameters, including water temperature and clarity. Additionally, bottom trawls were made in the vicinity of the discharge.

The State Water Resources Control Board reimbursed the Department for part of the expenses incurred during this study.

AREA DESCRIPTION

The City of Seaside discharges its domestic waste water through a 24 inch diameter pipe terminating in a 4 ft x 6 ft diffuser box 800 ft offshore in approximately 40 ft of water. The discharge point is about 3,800 yards NE of Monterey's Municipal Wharf No. 2 (Figure 1). The normal wet and dry weather flow is 1.3 million gallons per day (MGD).

The shoreline in the area is a sand beach facing the northwest and hence open to the prevailing NW wind and swell. The substrate throughout the study area was fine sand. No rock or hard substrate was encountered, however, occasional giant kelp plants (*Macrocystis* sp.) were present

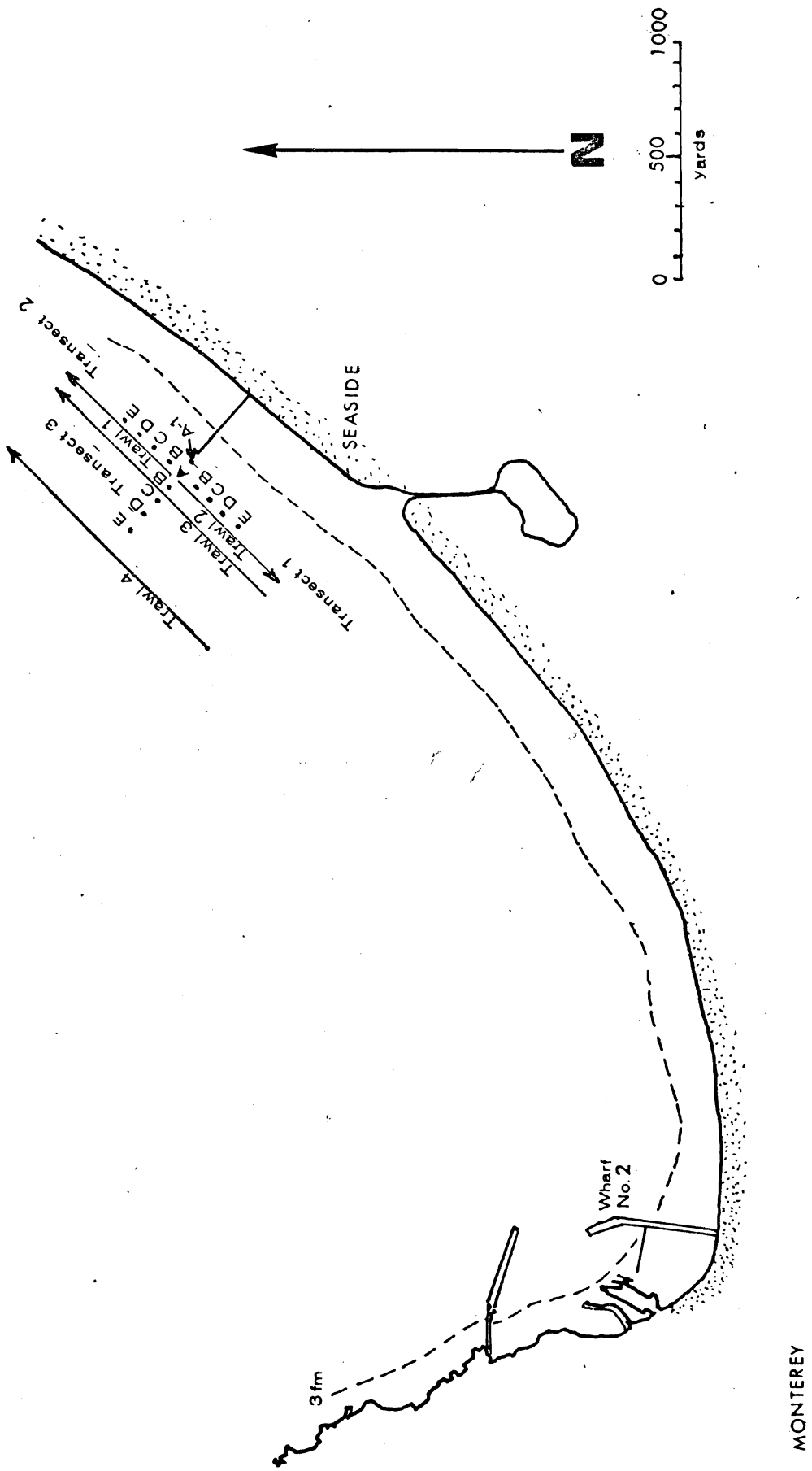

FIGURE 1. City of Seaside Ocean Discharge Sampling Locations, March 15 and 16, 1972

immediately south of the study area indicating the presence of hard substrate.

METHODS

Field operations were conducted by Department biologists on March 15 and 16, 1972, from the Department's 92 ft research vessel, KELP BASS.

Station sites were positioned at 250 ft intervals along three transects radiating out 1,000 ft from a point 250 ft offshore from the discharge (Figure 1). Due to shallow water and heavy swells, it was unsafe to position the vessel at discharge depth. However, one station was occupied within 50 ft of the discharge. The presence of a surface "boil" marking the end of the outfall was noted and this facilitated station location. Each sampling site was marked with an anchor and buoy and the vessel was anchored at the site. The station was then sampled from the surface, utilizing a $1/20m^2$ Ponar grab, and/or surveyed by biologist-divers equipped with a full face mask with surface air supply and diver-to-surface communications. Multiple grabs were combined when single grabs produced insufficient sediment for analysis.

Sediment samples collected by the Ponar grab were sifted through a 0.5mm screen and the biota were preserved in 10% formalin preparatory to sorting and identification in the laboratory.

Due to poor water visibility and strong bottom surge, a diver survey was not practical. Therefore, only three stations were occupied by divers and no quantitative sampling was conducted by the divers.

Water temperature and dissolved oxygen determinations were made with a Martek Model DOA in situ dissolved oxygen monitor. Visibility estimates were taken by the divers at three stations in 10 ft intervals from the surface to the bottom. General bottom conditions including

substrate description; height, period and direction of ripple marks; and the presence of suspended organic material (leptopel) in the water column and on the bottom were also noted by the divers.

Four trawls were made with a 16 ft head rope try-net with 1 inch stretch mesh and a 1/2 inch mesh liner in the cod end. Two of the trawls were of 5 minutes duration commencing 250 ft offshore the discharge and following the 7 fm isobath upcoast and downcoast from the discharge, and two trawls were of 10 minutes duration along the 8 and 10 fm isobaths directly offshore from the discharge (Figure 1). Trawling speed was 3-4 knots. All animals captured were saved and brought to the laboratory for identification and lengths in mm were taken for all post-larval fish.

Results - Physical

Surface water temperatures ranged from 12.9 C at Station A to 14.8 C at Stations 1-D and 3-C (Tables 1-4). Temperatures were more consistent at 40 ft of depth, ranging from 11.1 C at Station 1-E to 12.0 C at Stations A-1 and 2-C. The lowest temperature recorded was 10.1 C at 75 ft (Station 3-E).

Dissolved oxygen concentrations at the surface averaged 9.6 ppm, ranging from 10.0 to 9.2 ppm. Concentrations were generally highest at depths of 10 to 30 ft, then steadily decreased with increased depth, a situation similar to that found offshore from the Monterey ocean discharge (Hardy, 1973). The highest reading was 10.5 ppm at 20 ft (Station 1-B), and the lowest was 4.8 ppm at 75 ft (Station 3-E).

Water visibility estimates were made at Stations 1-B, 1-C, and 2-C. Surface visibilities ranged from 8 to 15 ft decreasing to 0.5 - 1 ft on the bottom. A surface slick of grease was noted in the immediate vicinity of the discharge and leptopel was noted in the water column at

TABLE 1. Temperature, Dissolved Oxygen and Visibility Profiles for Stations on Transect 1, City of Seaside Ocean Discharge, March 15, 1972

Station 1-B Time: 0845 Depth: 37 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Vis. (ft)	Comments
SS	13.0	10.0	15	Surface grease slick. Heavy
10	12.8	9.9	15	leptopel in water column.
20	12.4	10.5	15	Ripple marks confused. N-S
30	12.2	10.0	10	3" period 1/2" high; E-W 2-3'
37	11.9	7.6	0.5-3	period, 6" high. Fine sand, easily disturbed.

Station 1-C Time: 0940 Depth: 36 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Vis. (ft)	Comments
SS	13.1	9.8	15	No surface slick, some foam.
10	12.8	9.8	15	Leptopel starts at 10 ft depth.
20	12.7	10.2	10	Water quite dirty 4-5 ft off
30	12.2	9.8	10	bottom. Ripple marks confused.
36	-	-	1-2	N-S 3" period, 1/2" high. Occasional larger ripple.

Station 1-D Time: 0955 Depth: 35 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Vis. (ft)	Comments
SS	14.8	9.3	-	No dive made
10	14.0	9.6	-	
20	13.6	9.9	-	
30	14.0	9.6	-	
35	12.0	7.5	-	

Station 1-E Time: 1010 Depth: 45 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Vis. (ft)	Comments
SS	14.0	9.8	-	No dive made
10	13.2	9.8	-	
20	13.0	10.3	-	
30	12.1	7.1	-	
40	11.1	6.3	-	
45	10.9	6.4	-	

TABLE 2. Temperature, Dissolved Oxygen and Visibility Profiles for Stations on Transect 2, City of Seaside Ocean Discharge, March 15, 1972

Station 2-B Time: 0830 Depth: 45 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Vis. (ft)	Comments
SS	14.0	9.2	-	No dive made
10	13.8	9.6	-	
20	13.0	9.2	-	
30	12.2	9.2	-	
40	11.3	6.4	-	
45	11.1	6.3	-	

Station 2-C Time: 1040 Depth: 48 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Vis. (ft)	Comments
SS	13.8	9.3	8	Surface grease slick and foam.
10	13.0	9.6	10	Leptopel increases with depth,
20	12.9	9.8	10	very heavy near bottom. Unable
30	12.6	9.3	5	to see bottom. Bottom felt like
40	12.0	7.9	1	it was irregular with large and
45	-	-	0.5	small ripples.

Station 2-D Time: 1110 Depth: 48ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Vis. (ft)	Comments
SS	14.6	9.4	-	No dive made. Surface grease
10	13.9	9.4	-	film present.
20	13.3	9.4	-	
30	12.8	8.6	-	
40	11.9	6.4	-	
48	11.1	6.2	-	

Station 2-E Time: 1310 Depth: 35 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Vis. (ft)	Comments
SS	14.2	9.2	-	No dive made. No surface film.
10	13.8	9.0	-	
20	13.4	9.0	-	
30	13.0	8.9	-	
35	11.9	6.0	-	

TABLE 3. Temperature and Dissolved Oxygen Profiles for Stations on Transect 3, City of Seaside Ocean Discharge, March 15, 1972

Station 3-B Time: 1410 Depth: 51 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Comments
SS	14.0	9.7	No dive made
10	13.5	9.8	
20	13.0	9.4	
30	12.3	9.2	
40	11.3	6.3	
50	11.0	5.8	

Station 3-C Time: 1430 Depth: 59 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Comments
SS	14.8	9.8	No dive made
10	13.9	9.3	
20	12.8	9.2	
30	12.2	8.0	
40	11.2	6.3	
50	10.9	5.6	
59	10.9	5.5	

Station 3-D Time: 1450 Depth: 63 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Comments
SS	14.0	9.8	No dive made
10	13.6	10.0	
20	13.0	9.9	
30	12.3	8.7	
40	11.2	6.5	
50	10.8	6.0	
63	10.5	5.4	

Station 3-E Time: 1510 Depth: 75 ft

Depth (ft)	Temp. (C)	O_2 (ppm)	Comments
SS	14.0	9.8	No dive made
10	13.5	10.0	
20	12.9	10.0	
30	12.5	9.4	
40	11.5	7.2	
50	10.9	6.6	
60	10.2	5.2	
75	10.1	5.0	

TABLE 4. Temperature and Dissolved Oxygen Profiles for Stations A and A-1, City of Seaside Ocean Discharge, March 15 and 16, 1972

Station A-1 Time: 0945 Depth 40 ft Date: March 16

Depth (ft)	Temp. (C)	O_2 (ppm)	Comments
SS	13.2	9.4	No dive made
10	12.7	9.6	
20	12.5	9.4	
30	12.1	8.8	
40	12.0	8.6	

Station A Time: 0830 Depth: 45 ft Date: March 15

Depth (ft)	Temp. (C)	O_2 (ppm)	Comments
SS	12.9	9.8	No dive made
10	12.7	9.6	
20	12.5	9.9	
30	12.2	9.8	
45	11.9	7.9	

all three diving stations, generally increasing with depth.

The substrate was fine sand throughout the study area. Ripple marks indicate a shifting sand bottom along Transects 1 and 2, a result of the turbulent conditions prevailing adjacent to the surf zone.

Results - Benthic Grabs

The abundance and diversity of animals recorded at stations closest to the discharge, (Station A and A-1) were among the lowest recorded during the survey (Table 5).

Transects 1 and 2, extending upcoast and downcoast from Station A, were generally richer in overall abundance and diversity of marine life than were Stations A and A-1. Polychaetes, however, were still sparse, with no more than three polychaetes recorded from any station. The greatest increase in animal life was in crustaceans (Arthropoda). Within this group, cumaceans were generally the most abundant, however, ostracods were very abundant at one station. Juvenile sand dollars, *Dendraster excentricus* were present at all but one station.

Stations along Transect 3, extending offshore from the discharge, were generally richer in molluscs and polychaetes, while crustaceans were somewhat less abundant. Sand dollars dropped off in abundance, with only 2 appearing in the samples.

Results - Trawling

Trawl Station 1, starting at Station A and proceding NE along the 7 fm isobath, caught a total of 34 fish of 8 species, 14 unidentified larval fish and 22 invertebrates of 5 species (Table 6). Juvenile night smelt, *Spirinchus starksi*, were most abundant followed by spotfin surf-perch, *Hyperprosopon anale*, and speckled sanddab, *Citharichthys stigmaeus*.

TABLE 5. Animals Recorded from Ponar Grabs and Diver Observations in the Vicinity of City of Seaside Ocean Discharge, March 15-16, 1972

	Station and Abundance*														
			Transect 1					Transect 2				Transect 3			
	A	A-1	1-B	1-C	1-D	1-E	2-B	2-C	2-D	2-E	3-B	3-C	3-D	3-E	
No. of grabs	2	1	2	1	1	1	2	2	2	1	-	2	2	2	
Sediment Vol. (Liters)	4	1¼	1	1½	1½	1¼	2	3	2	3	-	3	4	4	Comments
Cnidaria															
Aglaophenia sp.	1														Diver pick-up
Nemertina															
unid.				13			P					1		1	Station 1-C tubed nemerteans
Annelida															
Polychaeta															
unid, fragments								1							
Amphareté labrops									1						
Chaetozone sp.				1	2									9	
Dispio sp.												1			
Cirratulidae	1									1			2	1	
Glycera sp.		1					1				1			3	
G. branchiopoda	1														
Goniada brunnea													1		
Hemipodus borealis													1		
Lanice (?) sp.													1		

TABLE 5. Contd.

	Station and Abundance*														
			Transect 1				Transect 2					Transect 3			
	A	A-1	1-B	1-C	1-D	1-E	2-B	2-C	2-D	2-E	3-B	3-C	3-D	3-E	
No. of grabs	2	1	2	1	1	1	2	2	2	1	-	2	2	2	
Sediment Vol. (Liters)	4	1¼	1	1½	1½	1¼	2	3	2	3	-	3	4	4	Comments
Lumbrineris acuta													1	5	
Magelona sp.												1		2	
Maldanidae												1		1	
Nephtys sp.			1				1				1	1	2	1	Station 3-D 2 species
Ophelia sp.				1											
O. pulchella														2	
Spio filicornis							1								
Spionidae					1										
Thalenessa spinosa				1								1			
Hirudinea				1											
Arthropoda															
Brachyura megalops	1	3		1											Larva
Brachyura unid.						1	2	2	2		1				Juveniles
Calanoida		1								6	2				
Cumacea		5	21	15	14	33	5	13	6	3	3	4	5	1	
Euphausiacea			3			2	3		1				6		
Gammaridae	2	1	3	2	1	3	7	3	5	4	1	3	3	2	

TABLE 5. Contd.

	Station and Abundance*														
			Transect 1					Transect 2				Transect 3			
	A	A-1	1-B	1-C	1-D	1-E	2-B	2-C	2-D	2-E	3-B	3-C	3-D	3-E	
No. of grabs	2	1	2	1	1	1	2	2	2	1	-	2	2	2	
Sediment Vol. (Liters)	4	1½	1	1½	1½	1½	2	3	2	3	-	3	4	4	Comments
Isopoda				2		3	1								
Mysidacea									3	1		4			
Ostracoda			1		1	83									
Mollusca															
Mitrella sp.									2						Juveniles
Nassarius perpingis											1				Juvenile
Olivella sp.				1											Diver observation
O. baetica													1		
O. biplicata											1				
O. pycnia	1	3	2	1		5		9	3	7	6	2	1	3	Station 2-D, 2 adult, 1 juvenile
Siliqua lucida						1									
Tellina sp.						1							1	1	Station 1-E, juvenile
T. bodegensis	1	2				2					2				Juveniles
Tricola sp.											1				
Echinodermata															
Dendraster excentricus		7	2	1		5	53	3	8	13		1		1	Juveniles, 1m - 52mm diameter

TABLE 5. Contd.

	Station and Abundance*														
			Transect 1					Transect 2				Transect 3			
	A	A-1	1-B	1-C	1-D	1-E	2-B	2-C	2-D	2-E	3-B	3-C	3-D	3-E	
No. of grabs	2	1	2	1	1	1	2	2	2	1	-	2	2	2	
Sediment Vol. (Liters)	4	1½	1	1½	1½	1½	2	3	2	3	-	3	4	4	Comments
Cephalochordata															
Branchiostoma sp.												1			
Chaetognatha															
Sagitta sp.						2	2			2	2	6	2		
VERTEBRATA															
Citharichthys sp.			3												Diver observation

* Abundance Symbol

P = Present in the area but relative abundance not estimated

TABLE 6. Fishes and Invertebrates Captured at Trawl Station 1, City of Seaside Ocean Discharge, March 15, 1972

Time: 1325-1330 Depth: 7 fms.

Species	Number	$\bar{X}$ S.L. mm	Range mm	Standard deviation
VERTEBRATA				
Citharichthys stigmaeus	6	45	39-55	6.7
Genyonemus lineatus	1	180	-	-
Hyperprosopon anale	9	104	73-117	13.8
Hypsopsetta guttulata	1	238	-	-
Larval fish (unid.)	12	-	-	-
Larval flatfish (right eyed)	2			
Psettichthys melanosticus	1	216	-	-
Raja binoculata	1	416(TL)	-	-
Spirinchus starksi (adult)	1	114	-	-
S. starksi (juvenile)	10	47	42-58	12.5
Stellerina xyosterna	4	77	57-84	11.3
INVERTEBRATA			Remarks	
Arthropoda				
Cancer antennarius	3		juveniles	
Crago nigromaculata	15			
C. stylirostris	1			
Pugettia dalli	1			
Spirontocaris sp.	2			

Fish captured were generally small with the exception of a 416 mm big skate, *Raja binoculata*. Unidentified larval fish, including right eyed flatfish, were also captured.

Five species of crustaceans were captured, with the shrimp, *Crago nigromaculata* being most abundant.

Trawl Station 2, running SW from buoy A along the 7 fm isobath, produced only 17 fish of 3 species and 1 species of invertebrate (Table 7). Speckled sanddab were most abundant followed by spotfin surfperch. Fish were generally small with the largest being a 265 mm (SL) diamond turbot, *Hypsopsetta guttulata*. The single species of invertebrate captured was the shrimp, *Crago nigromaculata*.

Trawl Station 3, proceeding NE along the 8 fm isobath outside the discharge, was the most productive with 160 fish of at least 12 species and 110 invertebrates (Table 8). Speckled sanddab were by far the most abundant fish taken, accounting for 74% of the catch. Fish were generally small, the largest being a 318 mm (SL) English sole, *Parophrys vetulus*. Unidentified larval fish, including right eyed flatfish, were also captured.

Crustaceans accounted for most of the invertebrates captured at Trawl Station 3 with *Crago nigromaculata* being most abundant. Also captured were two species of gastropod molluscs, *Nassarius fossatus* and *Olivella biplicata*, the sea star *Pisaster brevispinus* and one sand dollar.

Trawl Station 4 ran NE along the 10 fm isobath parallel to and seaward of the previous trawls. Sixty-four fish of at least 9 species and 22 invertebrates were captured (Table 9). Night smelt were the most abundant species, accounting for nearly 66% of the catch. As with the other trawls, the fish were all generally small with many juveniles and larval fish present. The largest fish captured was a 291 mm (SL) sand sole, *Psettichthys melanostictus*.

TABLE 7. Fishes and Invertebrates Captured at Trawl Station 2, City of Seaside Ocean Discharge, March 15, 1972

Time: 1357-1402 Depth: 7 fms.

Species	Number	$\bar{X}$ S.L. mm	Range mm	Standard deviation
VERTEBRATA				
Citharichthys stigmaeus	2	88	83-93	-
C. stigmaeus (juvenile)	10	41.4	31-50	1.96
Hyperprosopon anale	4	100	73-113	7.9
Hypsopsetta guttulata	1	265	-	-
INVERTEBRATA				
Arthropoda				
Crago nigromaculata	8			

TABLE 8. Fishes and Invertebrates Captured at Trawl Station 3, City of Seaside Ocean Discharge, March 16, 1972

Time: 0900-0910 Depth: 8 fms.

Species	Number	$\bar{X}$ S.L. mm	Range mm	Standard deviation
VERTEBRATA				
Citharichthys stigmaeus	119	-	20-112	-
Cymatogaster aggregata	3	73	67-84	-
Hyperprosopon anale	10	106	76-123	14.5
Larval fish (unid.)	2	-	-	-
Larval flatfish (right eyed)	6	-	-	-
Leptocottus armatus	2	131	120-142	-
Parophrys vetulus	2	293	267-318	-
Psettichthys melanostictus	1	-	317	-
Raja binoculata	2		173-180(TL)	-
Sebastes sp.	8	22	15-35	6.2
Stellerina xyosterna	4	71	32-110	27.6
Torpedo californica	1		No. meas.	

INVERTEBRATA		Remarks
Arthropoda		
Crago sp.	5	
C. nigricauda	3	
C. nigromaculata	94	
Lironeca vulgaris	2	ectoparasite on fish
Mollusca		
Nassarius fossatus	1	
Olivella biplicata	2	
Echinodermata		
Dendraster excentricus	1	
Pisaster brevispinus	2	

TABLE 9. Fishes and Invertebrates Captured at Trawl Station 4, City of Seaside Ocean Discharge, March 16, 1972

Time: 0930-0940 Depth: 10 fms

Species	Number	$\bar{X}$ S.L. mm	Range mm	Standard deviation
VERTEBRATA				
Citharichthys stigmaeus	4	37	33-39	2.3
Hyperprosopon anale	6	101	77-112	13.0
Larval fish (unid.)	4	27	24-31	2.7
Larval flatfish (right eyed)	1	-	19	-
Parophrys vetulus	1	-	310	-
Pleuronichthys decurrens	1	-	225	-
Psettichthys melanostictus	4	217	160-291	55.9
Spirinchus starksi	42(13 meas.)	99	48-116	18.8
Synodus lucioceps	1	-	238	-
INVERTEBRATA			Remarks	
Annelida				
Hirudinea	1			
Arthropoda				
Crago nigricauda	2			
Lironeca vulgaris	5		ectoparasite on fish	
Pugettia gracilis	1			
Spirontocaris sp.	9			
Mollusca				
Tegula montereyi	1			
Echinodermata				
Astropecten verrilli	1			
Dendraster excentricus	1		30 mm diameter	

Shrimp of the genus *Spirontocaris* were the most abundant invertebrate at Trawl Station 4 followed by the ectoparasitic isopod, *Lironeca vulgaris*. This isopod, however, is not considered a part of the benthic community and its presence in the trawl catch indicates its presence as a parasite on the trawl caught fish. The occurrence of a top snail, *Tegula montereyi* was unusual in that this species is normally associated with rock substrate and algae, and not with sand bottoms. Also present were the sea star *Astropecten verrilli* and a sand dollar.

DISCUSSION

The diversity and abundance of benthic animals were generally low throughout the study area, the lowest occurring at two stations nearest the discharge. Stations along Transects 1 and 2 exhibit similar faunal assemblages as those found nearest the discharge, with a slight increase in species diversity, and a sizeable increase in abundance of animals at two stations. The greatest increase in number of animals was at Station 1-E, where ostracods and cumaceans were very abundant, and at Station 2-B where a large number of sand dollars were encountered. Disregarding these two stations, the number and diversity of animals found at stations along Transects 1 and 2 were more comparable to those found at Station A-1.

The increase in molluscs and polychaetes along Transect 3 and the decrease in sand dollars reflects the change in habitat type from the shifting sand bottom just outside the surfline to the more stable fine sand bottom encountered in deeper areas. Sand dollars, *Dendraster excentricus* are commonly found just outside the surfline on shifting sand bottoms, which accounts for its abundance along Transects 1 and 2, whereas bottom condition along Transect 3 was better suited for molluscs and polychaetes.

The diversity and abundance of benthic animals throughout the study area were considerably lower than those found during a similar survey of the City of Monterey ocean discharge in March, 1972 (Hardy, 1973). The two outfalls, though in close proximity to each other, discharge into different habitat types. The Monterey outfall discharges onto a low profile sandstone reef supporting an extensive bed of giant kelp. The kelp bed, and the exposure of the Monterey outfall to the prevailing wind and swell, provides for a semi-protected habitat quite different from the situation present at the Seaside outfall. The Seaside outfall discharges into a shifting sand, open coast environment. Such habitats do not provide suitable habitat for diverse assemblages of plants and animals.

Trawl catches were generally small. The low catches were probably more a result of inefficient gear and heavy swells rather than to a lack of fish. Three species of fish dominated the catch; speckled sanddabs, night smelt, and spotfin surfperch. The lowest catch was made at Trawl Station 2. This was the only trawl made down coast, which may account for the low catch. The largest catch, Trawl Station 3, was made just seaward from Trawl Stations 1 and 2.

Fish were generally small with many unidentified larvae and juvenile fish present. Due to the small size of the net, the net may have been more selective to smaller fish. No neoplastic growths or other deformities were found on any of the fish captured.

CONCLUSIONS

The distribution of animals in the study area was more likely a function of substrate type and depth rather than a response to the discharge. The low number and diversity of animals found at the stations closest to the discharge might indicate an effect from the discharge.

However, the variation in abundance and diversity shown at other stations demonstrates the patchiness of the benthic populations and the need for more intensive sampling programs to adequately describe the parameters of these populations.

Dissolved oxygen concentrations were normal in the immediate vicinity of the discharge. The only physical manifestation of the outfall that we noticed was the surface slick in the immediate vicinity of the discharge.

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